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Request for grant of a patent

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22 JUN 1999

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Cardiff Road
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1. Your reference P24003/HGR/GMU

2. Patent application number *(The Patent Office will fill in this part)* **9914418.0**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Andrew Mark Stringer
14 Berkeley Close
Hill Head
Fareham
HAMPSHIRE
PO14 3NW

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

5568490021 mtz

4. Title of the invention

"Computer Network Payment System"

5. Name of your agent *(if you have one)*

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

373 Scotland Street
GLASGOW
G5 8QA

Patents ADP number *(if you know it)* 1198013

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

No

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Continuation sheets of this form	
Description	19
Claim(s)	0
Abstract	0
Drawing(s)	2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents	–
Translations of priority documents	–
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	–
Request for preliminary examination and search *(Patents Form 9/77)*	–
Request for substantive examination *(Patents Form 10/77)*	–
Any other documents *(please specify)*	–

11. I/We request the grant of a patent on the basis of this application.

Signature Murgitroyd & Company Date 21 June 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

Graham Murnane
0141 307 8400

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Computer network payment system

The invention relates to a system and method for transferring payments corresponding to the supply of information over a computer network. In particular the invention relates to a system and method for transmitting payment information between servers and clients by means of a hardware infrastructure of linked routers and by means of a specially adapted protocol, designated for the purpose of the description of the invention as a "PTP" or "Packet Tariff Protocol".

Access to the Internet is freely available everywhere and the advent of e-commerce, or electronic trading, is set to revolutionize the way that business is done. However there remains a requirement for effective trading of information itself. As the infrastructure and available bandwidth expand to appropriate levels, the world will become a single, on-line, global, multimedia library. All public domain information will be available to anyone with a network connection, via a simple, easy to use interface, analogous to today's Web browser application. In addition, suitable tools will be developed to manage the information and tailor all that is available to suit the particular needs of

each individual. There are two major consequences of this, as follows.

Firstly, holding information locally will become redundant. This means that books, CDs, prerecorded videotapes and so on will eventually not be required. When information is sufficiently cheap and reaches the necessary levels of specificity and availability, there will be no point in individuals holding local copies of the information, in the form of books, CDs, tapes etc., that will quickly go out of date. They will simply access the latest, updated information from its original source or retrieve other data (noting that any digital multimedia information is fundamentally just data) from on-line archives.

Secondly, broadcast media will also become redundant. Radio stations, TV channels, newspapers and journals will no longer serve any purpose. Once again, highly sophisticated information management tools will retrieve information from the massive range of disparate original sources that will come into existence, with the output collated, rationalized and customized to match the particular requirements of each networked individual.

These changes lie in the future, but are inevitable, and are likely to result in commercial upheaval and colossal social changes. At present, however, there remains a pressing need for a consistent and appropriate system or method to permit the implementation of this trade in information. The system must conform to, and operate under, the conditions that exist within free-market commercial and national economies. It is the development of a proposed solution to this problem which is addressed by

the present invention.

The PTP or "Packet Tariff Protocol" is an element within an effective system for digital networks at packet level. The protocol is envisaged as, but not limited to, an evolution of the existing TCP/IP standard that forms the core of the Internet as it presently exists.

According to a first aspect of the present invention there is provided a method of electronic payment for data transferred across a computer network containing at least one client, at least one server and at least one router which forwards data, the method comprising the steps of:

sending an electronic data request from a client to a server via one or more routers; and

sending electronic data from said server to said client via one or more routers in response to said electronic data request, said electronic data having associated with it a data field containing a value which represents the commercial value of the data contained within the electronic data.

Preferably the electronic data is transmitted in the form of packets. Preferably each of said one or more routers receives an incoming data packet, reads the value in the data field associated with the incoming data packet, calculates a new value based on the read value and the cost of forwarding the data packet, and forwards the data packet with the new value in the associated data field.

Preferably each of said one or more routers checks whether the value in the data field associated with the incoming data packet falls within predefined parameters

and rejects the packet if the value falls outside the predefined parameters. The parameters may depend on the source of the data packet or the originator of the data request.

The electronic data request may also have associated with it a data field containing a value which represents the commercial value of the data contained within the electronic data request.

Preferably total values for transactions between routers or between routers and servers/clients are recorded. These total values may be used as the basis for payments between the operators and/or users of the routers, servers or clients.

According to a second aspect of the present invention there is provided a system of electronic payment for data based on a hardware infrastructure of linked routers, data providers and data users, comprising:

at least one client;

at least one server for providing electronic data in the form of data packets in response to a request from a client and having its operation governed by a server protocol which causes each data packet sent by the server to have associated with it a data field representing the value of the data contained within the packet;

at least one router linked by a hardware infrastructure to said server and said client and having its operation governed by a routing table and a router protocol;

whereby the router protocol causes each router to add commercial value to the packet by forwarding it in accordance with the routing table and to update the value contained in the data field within the packet to

reflect this added commercial value.

Preferably the router protocol also includes procedures for rejecting individual packets in accordance with pre-defined parameters related to the value of each packet on receipt.

The invention will now be described, by way of example only, with reference to the accompanying figures, where:

Fig. 1 is a schematic representation of a typical generic form of a digital data packet under the system of the invention;

Fig. 2 is a schematic representation of a fragment of a network; and

Fig. 3 is a flow chart showing the operation of a network router under the system according to the invention.

The invention can best be understood by considering the metaphor of the supply chain with associated added value at each stage. In other words, at each step in the process to supply the information, value is added over and above the intrinsic value of the information. Therefore, an additional cost is associated with the information at each stage, until it reaches its ultimate destination. In practice, this is achieved by the incorporation of a "value" field into each data packet, allied with network protocol extensions to implement and utilize this field in the packet. This is applied in a way that ultimately results in the cost of providing the intrinsic information and the cost of providing the transport service being enumerated and

accrued in the value field. These costs are thus accounted for within the same system that actually provides the data transport service, so that the supply chain and the value chain are both incorporated into the network protocols.

The value field may be augmented with a "priority" field, along the lines that have already been proposed by other bodies as part of existing technical specifications. Within this framework though, the priority field can additionally be used as part of the commercial system if required, so that different services can incur different costs although they may share the same hardware and network infrastructure. In some prior art developments, the "priority" field of a data packet has evolved to serve a more advanced purpose, and the field contains a code that indicates how data should be handled, according to its characteristics. For example, transmission of data that is part of a video stream might not be re-tried if it fails first time, since a degraded video output is considered to be more useful to the ultimate end-user than a pause to wait for all the information to achieve perfect reproduction. In contrast, a file transfer can usually wait for the availability of network capacity, but must ultimately be one hundred percent complete, accurate and checked if it is to be of practical use.

In the system according to the invention, data is transferred between servers and clients in packets. Fig. 1 shows the typical generic form of a digital data packet under the implementation of PTP.

The packet in reality is simply data in a mutually understood format. In the example of Fig. 1, it is divided into three sections, which are separated in the

schematic representation by "**X**". Each section may be further divided into multiple fields, which are separated in the schematic by "/". The packet header contains fields for addressing information etc. and in the case of PTP also has what is referred to as the value field. The packet tail is optional, but would typically contain a checksum for the packet, or similar error detection information.

Each packet of data includes a value field, which contains information about the intrinsic value of the data contained within the packet, and which accumulates the charges made for each step in the provision of the service for supplying that data packet to its ultimate recipient. As an example, this aggregated overall worth may be measured in Network Credit Units (NCU's).

For the purpose of applying tariffs, the network system is considered to consist of "servers", "routers" and "clients" although in practice a single machine or even a single software application may fulfil more than one of these functions at different times. For example, a router can be considered to be acting as a client to many servers and as a server to many clients, as defined by the routing tables to which it adheres at any particular moment in time.

Fig. 2 is a diagram showing a network fragment. Under the system of the invention it may operate in the following manner. The Web client 1 requests information in the form of a message that passes through Router(N) 2 and accrues added value as a result of the action of the transport service. The message subsequently passes through Router(A) 3 and accrues more added value for the extra transport service. It then arrives at the Web server 4, which responds by

initiating a data stream. The packets of this data stream typically have intrinsic value, associated with the information that they contain. The appropriate component of this intrinsic value is recorded in each packet. The packets then pass via Router(A) 3 and have the associated value of the transport service added to them. Similarly, Router(N) 2 passes the data stream and adds further value to the packets for the service provided. The information finally arrives at the Web client 1, as required.

For each machine on the network, the net values of packets received and transmitted via each hardware connection can then be calculated. These values are reconciled by the owners of all the machines involved, as the basis for assessing the economic value of the services provided and calculating the commensurate hard currency exchanges required. This process is described in more detail below.

In accordance with the PTP idea, the Web client, or any software application functioning as a client, maintains the right to reject individual packets if they are deemed "too expensive" by some criteria, without assuming their associated notional cost. Additional control is maintained by monitoring the value of incoming packets in real time, typically by summing the total value arriving in the last second and/or minute and/or hour and/or other time interval, as required. This might, for example, be depicted by a meter representation or bar indicator on a network terminal screen. Over a short time period, of the order of a few seconds or so, it might be acceptable to have a large amount of data arriving with a large value at a high rate of value accrual, for example when downloading a software application. However over a

longer time period, of the order of an hour or so, a high rate of value accrual might be unacceptable while it might be acceptable to have a continuous stream of data arriving with a smaller value, for example when downloading a movie or video in real time. A meter representation could also apply to an Internet telephone, and the system could show the cost of a call as it takes place, rather than the owner subscribing to the service on a predetermined tariff scheme. This does not preclude a service provider agreeing to absorb the fluctuations in cost and passing on packets at agreed rates if such a service is desired by clients on the network. This might be appropriate, for example, if a client actually desired predetermined costs for use of the system, e.g. for budgeting purposes.

The invention is now described in more detail. For the purposes of the description herein, a packet originates from a server that acts as a "content provider", i.e. it is the source of the data or information contained within the packet that is to be transferred. This piece of information and the service of providing it both have some inherent worth and this worth can be enumerated and written in the value field of the packet. This is the first element of the system of the present invention, in that content providers can attach a value to the information that they provide and, further, they can assert the claim to that value along the same delivery channel as that by which the information itself is supplied. On receipt of the packet, the client (or router acting as a client) can accept the packet or reject it. The control system which makes the decision and determines the outcome of this choice is described later. It is of importance, because information cannot meaningfully be returned once received.

Assuming that a router receives and accepts a packet, it then acts in its role as a server and forwards it in accordance with the routing tables it currently holds. It should be noted that this always entails sending the packet down a physical data connection of some sort. The network is defined by the routing tables, but always has a physical existence as data conduits between machines. In the system of the invention, the routing machine defines the worth associated with the action of passing a packet from one machine to the next. It might be a fixed rate, or it might be dependent on the priority of the packet or on some other parameters (e.g. network loading, time of day, physical distance between machines, available bandwidth, ownership of network infrastructure, etc.). The important point is that this evaluation can be resolved by the router (probably as part of its routing software) as it passes the packet and that the outcome of this calculation is added to the value field of the packet in transition (i.e., before it is forwarded). This is the second element of the system of the present invention, in that network infrastructure providers can attach a value to the service of transporting information and, further, they can assert the claim to that value along the same delivery channel as that by which the information itself is supplied. It is also necessary for each machine to accumulate the total number of NCU's it receives from each physical connection and the total number of NCU's it dispatches to each physical connection, excluding those attributed to packets that are subsequently rejected. It should also be noted that physical connections for the receipt of packets are considered to be distinct from physical connections for the dispatch of packets, even though they might be manifested in the same piece of cabling.

Under these conditions, the number of NCU's transmitted from the machine at one end of a physical connection should agree with the number of NCU's accepted by the machine at the other end. These machines may be owned by different organizations but, on the basis that they agreed to make the trades, they should be reasonably expected to have mutual interest in ensuring accuracy in accounting. A commercial analogy for this would be a deal done on an "open outcry" trading floor, in which two parties agree a deal by signals and each makes a record of it independently. The independent records are reconciled at a later stage but, since both parties agreed the initial deal, both are assumed to have an interest in making sure that it is recorded accurately. The analogy goes further, since any party that establishes a reputation for not recording deals accurately will simply find it impossible to establish or maintain any profitable trades.

Within this protocol, any recipient reserves the right to reject any packet. This rejection includes refusal to accept the debt associated with receipt of the packet. The most probable reason for this is that the packet is deemed by some criteria to be "too expensive". This act of rejection is an important part of the protocol and therefore warrants detailed discussion. As discussed above, once data is received it cannot be meaningfully returned, since it is not a physical object. On first inspection, then, it seems that there would be a propensity to defraud suppliers by rejecting packets (and therefore the liability to pay for them) whilst still forwarding the data and charging for it. However, the post-receipt rejection process is vital to remove completely the possibility that single "rogue" packets of massive value are foisted on unsuspecting recipients. The reason that an

immediate breakdown of the system according to the invention does not follow is because successful trading requires streams of many packets of modest value to be passed through the network. In the proposed scenario, the "catch 'em once" price-value combination is excluded by this ability to refuse to pay for excessively costly packets. This means that a sustainable and profitable trade will only occur with the transmission of an ongoing packet stream.

This "reject" aspect of the system according to the invention may best be understood by considering a "sale or return" analogy. A producer (content provider) creates a product (data/information) and delivers it to a reseller (router) at some cost (the value in NCU's). The reseller (router) either accepts it, on the basis that it can be sold on (forwarded to another router or an end client) at a marked up price (an addition to the value in NCU's) or, alternatively, rejects it. The producer (content provider) monitors the rejections of the reseller (router) and decides on the basis of this information whether or not to continue trading and, if so, what price structure to apply. Hence, the choice of acceptance or rejection of a packet is effectively a "sale or return" of the data, since keeping occasional packets without paying for them is of little economic value. In practice, it will rapidly become the case that meaningful trade in packet streams allied to competitive pricing is the only way to maintain profitable transactions.

Termination criteria are based upon single packet costs and the cost accumulations of packets over selected time intervals. Hence termination requests are issued if any single packet exceeds the NCU threshold or if the limits for NCU's per second, minute, hour, day

and/or other time interval are exceeded. The cut-off levels are best kept confidential to avoid prices being bumped up to the maximum that would be accepted, although such information could be shared with trusted counterparts in an attempt to reject packets deemed too costly at an earlier stage. Note that single-packet rejection is the only rejection where packets are not paid for, other termination is simply a request to cease supplying data. Data received before supply terminates are still paid for, subject to single packet criteria.

Conversely, the value attributed to data by content providers could be freely advertised. This would make competition between content providers more effective and would also highlight expensive transport routes, since the value of the packet received would have had risen unacceptably when compared to the initial value advertised by the content provider. Furthermore, data network routing should become an extremely efficient market because data transmission networks can be reconfigured so easily and pricing structures changed so readily. This should result in perfect competition, evolving to satisfy the laws of supply and demand in a free market.

The final element of the system according to the invention is achieved by converting the residual difference in NCU's exchanged between a pair of machines over some physical connection into a payment in mutually acceptable hard currency. This can always be achieved bilaterally, but could also be administered by some kind of clearing house with responsibility for a defined physical region of the network. There is a potential problem here, unless the exchange value of an NCU is pegged to some hard currency. Otherwise, it

will float erratically as the number of NCU's per network transaction can vary inversely with the exchange rate to hard currency, without changing the actual monetary worth of the network transaction. The problem might however eventually resolve itself if the NCU becomes a stable, global currency in its own right.

To complete a transaction using this system, an ultimate client could first issue a request for some information. For the purpose of this example only, it will be assumed that this request is contained in a single packet. The intrinsic value of this packet would probably be zero but, in all cases, could not exceed a predetermined maximum accepted by the router (which may well be the machine of a network service provider, acting at this point as a client). Further, since this machine is probably not owned by the owner of the ultimate client machine, there would be no tariff added to the value of the packet. The router, now acting as a server, adds a tariff to the packet and passes it to the next router. This process is repeated across the network until the packet reaches the machine of the content provider that, somewhat confusingly, is at this point acting as a client. Hence, the content provider receives a request for information but becomes liable for the accrued value of the packet. This value will be relatively small, since it is only one packet (or, more generally in practice, a relatively small number of packets) and it has little or no intrinsic value in its information content. It can be thought of as analogous to the cost associated with a free-phone telephone number that businesses commonly use to attract enquiries from customers.

The machine of the content provider now acts in its primary role as a server, and starts to send packets

addressed to the machine of the ultimate client (i.e. the machine from which the original request for data originated). Since the packets have content that is deemed to have some worth, these packets now have a significant value associated with them even as they are dispatched from the server machine. As they traverse the network, they will accrue further value until they reach the ultimate client machine. Routers within the network will have added value to packets passing both ways, so that owners of these machines will be in residual credit after paying for the packets received and will therefore be able to reclaim hard currency converted from NCU's to finance their activities. The content providers will have some liabilities for the receipt of the packets requesting data but will have a large residual credit for supplying the information. The ultimate client will contribute the majority of the payments due, which cover the cost of the information they receive and the cost of the process of transporting it to them.

The way in which a network router might implement the PTP, in addition to its existing transport protocol, for the purposes of transferring data packets and accumulating the associated tariffs, is illustrated in the flow chart of Fig. 3. The "crow's foot" arrowheads 5 show possible contingencies at various stages, if the required conditions are not satisfied.

For each hardware connection, the total value transmitted minus the total value received (e.g. in Network Credit Units) is the net profit (or loss) that must be reconciled with the owner of the machine at the other end of that hardware connection. This is used to determine the economic value of the accumulated transactions and forms the basis of the hard currency

exchanges necessary to finance the activities and the provision of the infrastructure.

Physical network connections can be created and re-arranged relatively easily and network service providers can normally be changed at will. It is therefore anticipated that the kind of business system envisaged by the present invention will lead to a very efficient market constituted of very many providers of connections and routing bandwidth who serve, collectively, a very large number of content providers and information consumers. For example, if the financial arrangements were controlled in this manner, it might reasonably be envisaged that the infrastructure would evolve to support video on demand. This would be based upon an enormous supply of material, effectively a distributed archive of all the material ever produced. It would satisfy the market by the laws of supply and demand.

One of the major problems associated with any data distribution, and particularly digital data, is that of unauthorized redistribution. Matters of privacy and security are also general problems in the context of the Internet. For the purposes of the description of the invention, it is necessary only to consider whether the use of PTP implies any changes as compared to the situation at present. The system of the invention does not require transfer of data in ways other than those presently possible, and the proposed protocol of the invention would not inhibit any of the security or encryption methods used to prevent such unauthorised redistribution. In fact, security and encryption would be expected to take place at the level of the data within the packet stream, rather than acting at the packet level itself.

One important feature of the system of the invention is that it allows consumers to choose exactly what they require without having to pay for unwanted accompanying material. For example, they can select one track without having to pay for a complete music CD, or they can decide not to view the remainder of a film if they dislike the opening portion. Also, the purchase price should be subject to very keen competition. These facts in themselves mean that there is less temptation to acquire material from illegal sources. Any legal deterrents become more effective if individuals can buy selectively only what they actually require, and at a fair price.

In addition, as individuals are presented with, and begin to utilize, the much greater choice of available information, their interests will rapidly diversify and their requirements will diverge. This will have the effect of making it more difficult to cache data as it passes through the network and resell it multiple times. If content becomes sufficiently cheap, it will not be worth the investment in hardware to cache it. There will be less demand for any particular content, so that the logistics of illegal storage for reselling become more expensive and therefore less attractive. This is not to say that a legal business of caching and reselling popular information could not build up, still within this framework. This could, for example, be how what are now broadcast services continue to make money. Network capacity will need a large step-change before commonly required content can be served to all clients from a single source, a matter which is presently addressed by the use of network caches, proxy servers and mirror sites on the Web. Such issues are tied in with copyright and ownership of content. For example, it is not generally possible for an end-user to tell

whether content comes from its original provider or from some legitimate or illegitimate cache. Once again, the implementation of the system of the invention would not impact upon these matters of copyright and ownership of content.

The system of the invention as described above can also function with the concept of the network computer, which for example means that a user might have the option of purchasing the use of a software application for some period rather than actually buying the application outright. Once again, they receive (and pay for) only what they actually require, and always get the most up to date version so that rapid obsolescence is not a concern.

One other important feature of the PTP concept is that it can be interfaced with a conventional network, operating under a different business model, provided charging rates and so forth are agreed for the interfaces. This means that network fragments can be created or converted to conform to the PTP model as and when suits the infrastructure owner, so that gradual conversion is possible and a massive "roll-out" program is unnecessary.

It is possible that, for effective operation, the system of the invention will require international financing deals and clearing arrangements, as well as software controlled real-time network configuration changes and real-time pricing structure changes. However, the system of the invention offers two significant advantages, as follows. Firstly, the ultimate client always has transparent data on what the service being received is actually costing, over any desired time interval. This is regardless of the

choice of information source, network service or demand driven costing changes. Secondly, PTP represent a good approximation to a perfectly competitive and efficient market, and one in which the costs and revenues are intimately related at all stages to the actual activities from which they result. These features should be expected to encourage serious investment into infrastructure development.

These and other modifications and improvements can be incorporated without departing from the scope of the invention.

Typical generic form of a digital data packet under the implementation of PTP.

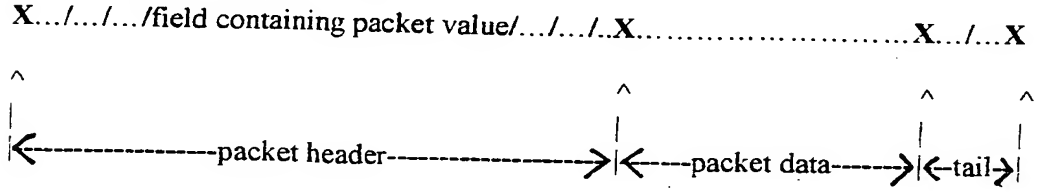

FIG. 1

Diagram showing a network fragment and an accompanying description of how it might operate under PTP.

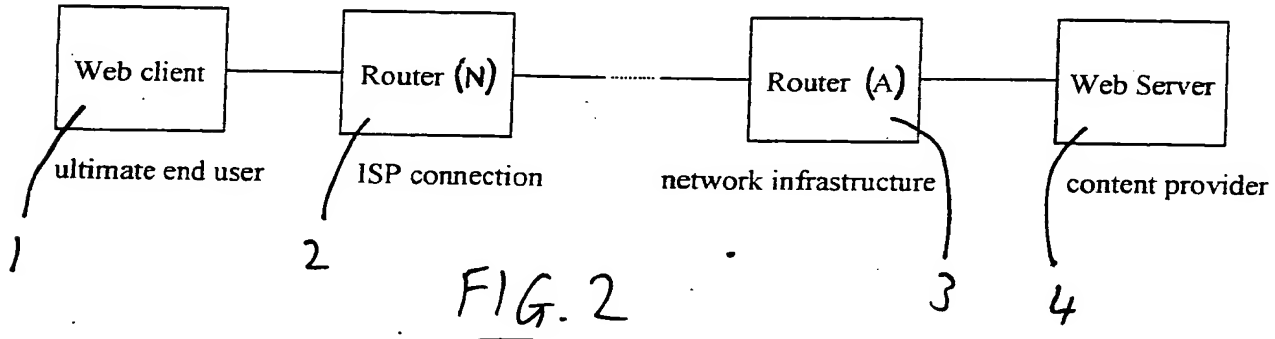

FIG. 2

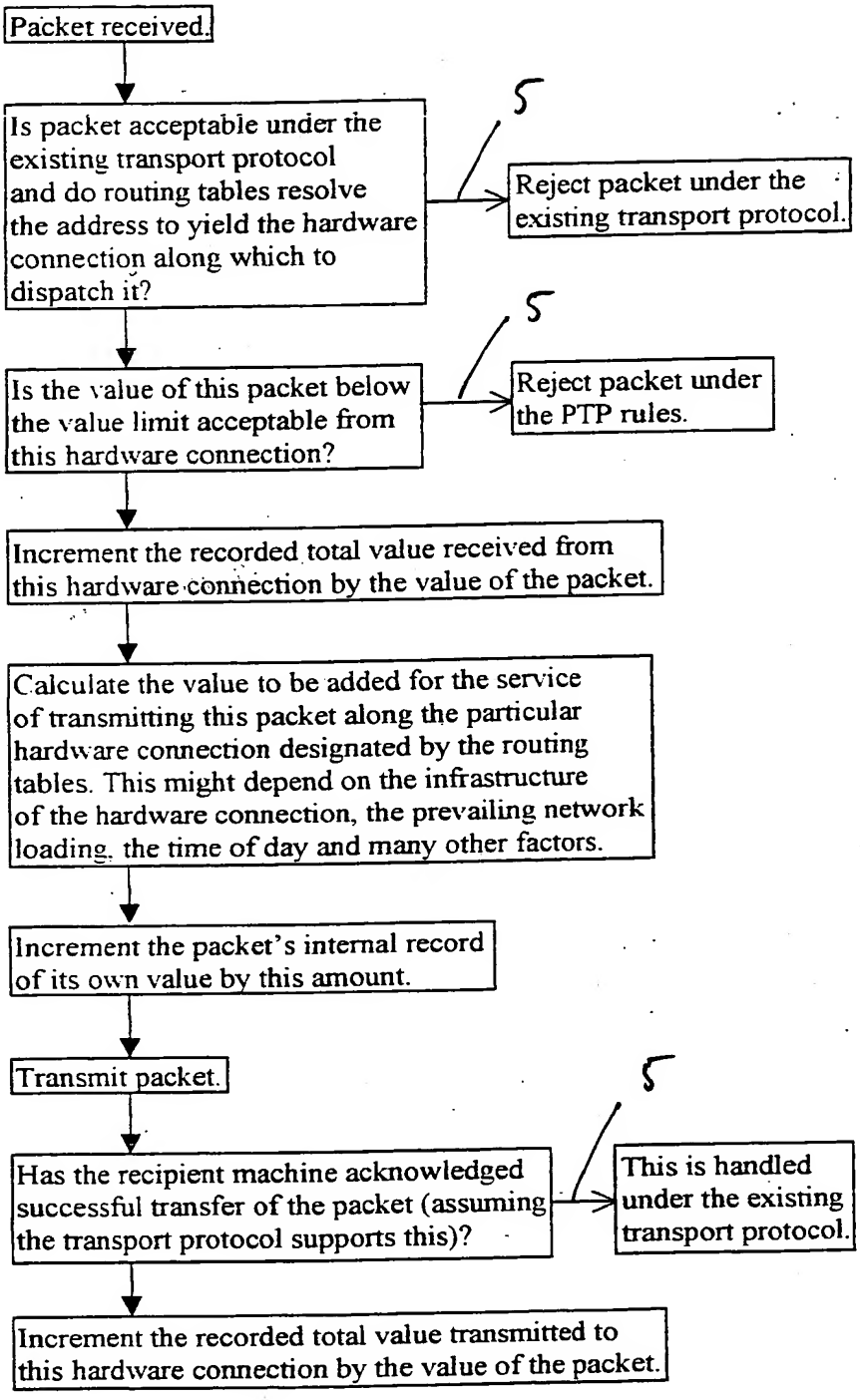
Packet received.
Is packet acceptable under the existing transport protocol and do routing tables resolve the address to yield the hardware connection along which to dispatch it?
5
Reject packet under the existing transport protocol.
Is the value of this packet below the value limit acceptable from this hardware connection?
5
Reject packet under the PTP rules.
Increment the recorded total value received from this hardware connection by the value of the packet.
Calculate the value to be added for the service of transmitting this packet along the particular hardware connection designated by the routing tables. This might depend on the infrastructure of the hardware connection, the prevailing network loading, the time of day and many other factors.
Increment the packet's internal record of its own value by this amount.
Transmit packet.
Has the recipient machine acknowledged successful transfer of the packet (assuming the transport protocol supports this)?
5
This is handled under the existing transport protocol.
Increment the recorded total value transmitted to this hardware connection by the value of the packet.

FIG. 3